

**REMARKS**

The Office Action of July 13, 2006 has been received and its contents carefully considered.

Claims 1, 4-8, 11-14, 29-31 and 52-71 are currently pending in this application. In this Amendment, claims 4 and 11 are canceled without prejudice to or waiver of the subject matter recited therein. Claims 1, 5-8, 12-14, 29-30, 59, 64 and 69 are amended herein to more clearly distinguish over the applied prior art.

In the Action, claims 31, 63, 68 and 71 are rejected under 35 U.S.C. §112, first paragraph, as failing to comply with the written description requirement. Specifically, the Examiner asserts that the limitation recited in these claims, “expresses cloud water content as a function of exceedance probability and said selected region’s latitude and longitude,” is not supported by the original specification. The rejection is respectfully traversed for the following reasons.

The limitation in question refers to the cloud water content formula shown in Figure 7 of the present application. As noted at page 16, lines 14-18 of the application, the method of the present invention calculates the cloud water content (in  $\text{g/m}^2$ ) for a zenith communications link according to the formula in Figure 7, where PR = exceedance probability, and LON and LAT are earth station locations in longitude and latitude(degrees), respectively. From the context of the application, it is clear that the inventive method of calculating cloud water content is not specific to any particular embodiment of the invention, but rather applicable to all of them. Accordingly, the Applicant respectfully requests that the §112, first paragraph, rejection of claims 31, 63, 68 and 71 be reconsidered and withdrawn.

In the Action, claims 53, 56, 61 and 66 are rejected under 35 U.S.C. §112, first paragraph, as failing to comply with the written description requirement. Specifically, the Examiner asserts that in claims 53, 61 and 66, the limitation, “said elliptical orbit is inclined at critical inclination,” is not supported by the original specification. Similarly, with regard to claim 56, the Examiner asserts that the limitation, “said Molniya orbit is inclined at critical

inclination,” is not supported by the original specification. These rejections are respectfully traversed for the following reasons.

As disclosed in the application (page 19, line 3), the Molniya orbit is an elliptical 24-hour orbit having the parameters  $i = 63.425$  deg. And  $e = 0.725$ . An inclination,  $i$ , of 63.4 deg. is known to those of ordinary skill in the art as “critical inclination” because it results in an orbit whose apogee always stays at the same latitude in the same hemisphere and is not affected by certain asymmetries in the shape of the Earth (see, for example, U.S. Patent 6,954,613, column 6, lines 47-58). This applies not only to the Molniya orbit, but to any other elliptical orbit inclined to the equatorial plane. Accordingly, the Applicant respectfully requests that the §112, first paragraph, rejections of claims 53, 56, 61 and 66 be reconsidered and withdrawn.

In the Action, claims 1, 4, 7, 29, 52 and 53 are rejected under 35 U.S.C. 103(a) as being obvious over Mendenhall et al. (U.S. Patent No. 6,535,314) in view of Badesha et al. (U.S. Pat. Appl. Publ. No. 2002/0167702) or Draim et al. (J. Draim et al., “Expanding Global Communications Capacity Using Higher Frequency Bands with Elliptical Satellite Constellations,” 2000, IDS provided by Applicant). Independent claims 1 and 29 are amended herein to more clearly distinguish the rejected claims over the applied prior art combination.

With regard to claims 1 and 29, the Examiner points to Mendenhall as teaching a satellite communications system comprising: a terrestrial base station (Fig. 1B, 26); and a first satellite (Fig. 1B, 10) communicating with said terrestrial base station using an infrared signal (optical beam, column 6, lines 63-64). However, the Examiner acknowledges in the Office Action that Mendenhall fails to teach the limitations that an optimal location of the terrestrial base station is determined based on a wavelength of the infrared signal and an attenuation of the infrared signal between the terrestrial base station and the satellite at the wavelength, and that the attenuation is determined based on a cloud water content for communication at zenith, persisting in a region in which the terrestrial base station is located.

To remedy the deficiencies in Mendenhall, the Examiner asserts Badesha discloses that clouds, rain and fog can scatter optical beam energy and disrupt communications (page 1, paragraph 0005, lines 8-10). The Examiner further asserts Badesha teaches that one approach to mitigate the problem is to have several ground stations at different locations so that a

transmission can be sent from the ground station that is least obstructed (optimal location) by clouds (page 1, paragraph 0006). The Examiner asserts that likewise, Draim discloses to select an optimal location for the terrestrial station to minimize the attenuation of the optical signals (the entire article). The Examiner argues that it would have been obvious for one of ordinary skill in the art at the time the invention was made to select an optimal location for terrestrial base station based on the minimal attenuation of the optical signals which is a function of the wavelength of the infrared signal and the and the cloud water content for communication at zenith, persisting in a region in which the terrestrial base station is located, in order to provide a reliable communication capability.

The applicant respectfully disagrees. The Mendenhall reference is directed to an apparatus and method that can be used in a satellite system for acquisition and tracking of an optical communications beam (see Abstract). With regard to the issue of frequency selection, Mendenhall refers to the “sending and receiving of beams 16 and 17,” (column 6, lines 63-64), stating that” for example, beam 16 is transmitted at 1.554 microns and that beam 17 is transmitted at 1.546 microns” (column 7, lines 4-5), which are close to the visible spectrum. Mendenhall fails entirely to teach the advantageous use of longer wavelength signals in the infrared spectrum, as required by all of the independent claims, including claims 1 and 29, to significantly reduce path attenuation.

The Badesha reference is directed to an optical communication system using a high altitude tethered balloon that operates above most clouds and atmospheric turbulence. A balloon-based optical transceiver maintains line of sight optical communication with a satellite. Data is transmitted to a ground station from the balloon through a fiber optic channel attached to the tether (see Abstract). Thus, Badesha is not directly relevant to the current application because the balloon with its closed fiber optic connection to the ground station largely avoids the atmospheric attenuation problems to which the present invention is addressed.

The text in Badesha relied upon by the Examiner (paragraph 0006) describes a prior art system that mitigates some of the short term variations in the attenuation of optical signals, caused by cloud cover, by using a plurality of earth stations in the same region that are spaced a minimum distance apart (e.g., 200 km). In such a “diversity” system, the communication path used at any particular time is the one that yields the best communications performance. As

Badesha points out, the cost of the multiple earth stations and inter-facility links required by such a diversity system can be prohibitive.

By contrast, claims 1 and 29 of the present application require the optimal location of a terrestrial base station to be determined based on the attenuation of an infrared signal, which is determined based on a cloud water content for communication at zenith at the location of the terrestrial base station. Badesha does not specifically teach using cloud water content persisting in the region of the terrestrial base station to determine the attenuation of an infrared signal. In a diversity system, the selection at any particular time of a terrestrial base station to provide the communications link is based solely on minimum link attenuation, and consideration of cloud water content, as such, is not relevant. Further, it is noted that Badesha does not specifically teach the use of an infrared signal for communications. It is submitted that, as in Mendenhall, the term “optical” communications in Badesha refers to the use of signals with much shorter wavelengths in or near the visible spectrum.

The Draim et al. paper is directed to the advantages of using a satellite in an inclined elliptical orbit having an apogee at or near zenith for the terrestrial base station, in order to significantly reduce path length through the atmosphere and the resulting atmospheric attenuation. However, the discussion in Draim et al. is limited to a consideration of attenuation at millimeter wave frequencies, up to about 90 GHz, well short of the infrared region. Moreover, the results in Draim are based on the zenith attenuation maps for millimeter wave frequencies presented in Barbaliscia et al. (Barbaliscia, Boumis and Martelucci, “World Wide Maps of Non Rainy Attenuation for Low Margin Satcom Systems Operating in SHF/EHF Bands,” Ka Band Conference, 1998, IDS provided by Applicant). Thus, it is respectfully submitted that the prior art combination relied upon by the Examiner fails to teach the advantageous use of an infrared signal for communication between a satellite and a terrestrial base station, and determining an attenuation of the infrared signal based on cloud water content for communication at zenith, persisting in a region in which said terrestrial base station is located, as the claims require.

As disclosed in the application, the prior art in Chu and Hogg (The Bell System Technical Journal, May-June 1968, Vol. 47, No. 5, pp 723-759, IDS provided by Applicant) discloses the calculation of attenuation for optical and infrared signals passing through rain and fog. However, the results in Chu and Hogg, which relate attenuation to water vapor density,

are limited to terrestrial communications where the water vapor density of ground fog can be quantified (see application page 13, line 17 through page 14, line 11).

For determining the attenuation of infrared signals in satellite communications applications due to cloud cover, the present invention utilizes the empirical models for atmospheric attenuation at millimeter wave frequencies (22.2 and 49.5 GHz) reported in Barbaliscia et al. (cited above), to derive a general expression for cloud water content for communication at zenith (see application Figure 7 and discussion at page 14, line 12 through page 16, line 17). Combining these new results with Chu and Hogg allows cloud attenuation at infrared wavelengths to be determined for the purposes of selecting an optimal location for a terrestrial base station.

To reflect this novel aspect of the present invention and further distinguish over the prior art, claim 1 is amended to include the limitation, "wherein said cloud water content is determined based on an empirical model for millimeter wave attenuation at zenith in said region." Similar new language is added herein to claim 29, as well as the other independent claims in the application. This limitation is not taught or suggested by any of the applied references.

For the foregoing reasons, it is respectfully submitted that amended independent claims 1 and 29, as well as dependent claims 7, 52 and 53, patentably distinguish over the Mendenhall, Badesha and Draim references, whether considered individually or in combination.

In the Action, claims 8, 11, 14, 55-56, 59-61 and 64-66 are rejected under 35 U.S.C. 103(a) as being obvious over Mendenhall in view of Badesha or Draim further in view of Ross et al. (U.S. Patent No. 5,218,467). As noted earlier, independent claims 8, 59 and 64 are amended herein to more clearly distinguish the rejected claims over the base combination of Mendenhall, Badesha and Draim.

Further, regarding claims 8, 59 and 64, the Examiner acknowledges in the Office Action that Mendenhall and Bedesha, or Mendenhall and Draim do not teach that the system further comprises a second satellite, a third satellite, a forth satellite and a fifth satellite, the first satellite, the second satellite and the third satellite each being in a phased Molniya orbit, and the fourth satellite and the fifth satellite each being in a geosynchronous orbit. However, the Examiner points to the Ross reference as teaching a satellite communications system

having a synchronous satellite (Fig. 1, 1) communicating with six Molniya orbit satellites. Therefore, argues the Examiner, it would have been obvious for one of ordinary skill in the art at the time the invention was made to include more than one geosynchronous satellite and a plurality of Molniya orbit satellites in the satellite communications system taught by Mendenhall and Bedesha, or Mendenhall and Draim to increase the area that the satellite communication system covers.

The applicant respectfully disagrees with Examiner's argument. Ross is directed to a satellite system for optical communications in which up to six low earth orbiting satellites send satellite data, which is relayed to a ground station on the earth's surface (see Abstract). However, the system disclosed in Ross differs from the claimed invention in several important respects. First, the constellation of data collection satellites in Ross are disclosed as being in low earth orbits, not the Molniya orbits specified in claim 8. A Molniya orbit is a 12-hour elliptical orbit, in which the satellite, while at or near apogee, occupies a location far above the Northern hemisphere for up to eight hours (see, for example, application Figure 17).

Second, amended claim 8 recites "a constellation of satellites each communicating directly with said terrestrial base station using an infrared signal," while claim 64 recites "a first satellite adapted to communicate with said terrestrial base station using a first infrared signal; and a second satellite adapted to communicate with said terrestrial base station using a second infrared signal" (emphasis added). In Ross, by contrast, the terrestrial base station 3 (Fig. 1) communicates only with the geostationary satellite 1, which acts as a relay point for data from the low earth satellites 2 (column 2, lines 32-51). The system in Ross does not provide for communication by the terrestrial base station directly with each of the low earth orbit satellites, as claim 8 would require. Moreover, each of the low earth orbit satellites in Ross communicates over an optical link with the geosynchronous satellite, but the communication link between the geosynchronous satellite and the terrestrial base station is RF. Thus Ross fails to disclose communication directly with the terrestrial base station using an infrared signal, as claims 8 and 64 require.

Lastly, claim 59 is directed to a diversity system in which there are two terrestrial base stations communicating with a single satellite using infrared signals. It would appear that this claim does not read on Ross at all.

For at least the forgoing reasons, it is respectfully submitted that independent claims 8, 59 and 64, as amended, as well as dependent claims 14, 55-56, 60-61 and 65-66, patentably distinguish over the applied references, whether considered individually or in combination.

In the Action, Claim 69 is rejected under 35 U.S.C. 103(a) as being obvious over Mendenhall in view of Badesha or Draim further in view of Colella (N. Colella et al., "The HALO Network," IEEE Communication Magazine, June 2000, pages 142-148). As noted earlier, independent claims 69 is amended herein to more clearly distinguish the rejected claim over the base combination of Mendenhall, Badesha and Draim.

Further, the Examiner acknowledges in the Office Action that Mendenhall and Bedesha, or Mendenhall and Draim do not teach that the system comprises an aircraft that flies at high altitude in a closed path so as to be able to communicate continuously with the terrestrial base station. However, the Examiner asserts that a communications system using a high altitude aircraft is well known in the art and that it would have been obvious for one of ordinary skill in the art at the time the invention was made to incorporate a high altitude aircraft to replace the satellite in the modified satellite communications system of Mendenhall and Bedesha, or Mendenhall and Draim in order to serve a metropolitan area with lower cost.

The Applicant respectfully disagrees. The HALO system disclosed in Colella operates at millimeter wave frequencies (28 or 38GHz) (see for example, Figure 1). Colella does not address the significant deficiencies in the teachings of the base combination regarding ground-satellite communication at infrared wavelengths, which were pointed out above in connection with amended claims 1 and 29. Accordingly, it is respectfully submitted that amended claim 69 patentably distinguishes over the applied references, whether considered individually or in combination.

In the Office Action, claims 54 and 58 are rejected under 35 U.S.C. 103(a) as being obvious over Mendenhall in view of Badesha and further in view of Fletcher et al. (U.S. Patent No. 4,025,783); claims 57, 62 and 67 are rejected under 35 U.S.C. 103(a) as being obvious over Mendenhall in view of Badesha and Ross and further in view of Fletcher; and claim 70 is rejected under 35 U.S.C. 103(a) as being obvious over Mendenhall in view of Badesha and Colella and further in view of Fletcher. As noted earlier, the independent claims are already

amended herein to more clearly distinguish the rejected claims over their respective base combinations.

Further, in each case, the Examiner acknowledges in the Office Action that the base combination does not teach that the wavelength of the infrared signal is about 10 microns. However, the Examiner asserts that use of an optical signal of about 10 microns is well known in the art and that it would have been obvious for one of ordinary skill in the art at the time the invention was made to use a 10 micron wavelength optical signal to carry information in the system defined by the base references to reduce the signal attenuation by clouds.

The Applicant respectfully disagrees. Fletcher is directed to a Gregorian all-reflector optical system for space communications applications. The text in Fletcher referenced by the Examiner discusses the utility of using infrared signals for communication between data relay satellites as well as between satellites and spacecraft. However there is no teaching or suggestion in Fletcher that infrared signals in the range of 10 microns wavelength can be used advantageously for ground-to-satellite communications by judiciously selecting terrestrial base station locations to minimize the attenuation resulting from cloud water content, or of a method for determining cloud water content persisting at such locations. Hence, Fletcher fails to address the real deficiencies in the teachings of the base combinations regarding ground-satellite communication at infrared wavelengths, which were pointed out above in the discussion of claims 1 and 29 and the other independent claims. Accordingly, it is respectfully submitted that claims 54, 57, 58, 62, 67 and 70 patentably distinguish over the applied references, whether considered individually or in combination.

In the Office Action, claim 6 is rejected under 35 U.S.C. 103(a) as being obvious over Mendenhall in view of Badesha and further in view of Chu and Hogg (cited above); claims 13, 63 and 68 are rejected under 35 U.S.C. 103(a) as being obvious over Mendenhall in view of Badesha and Ross and further in view of Chu and Hogg; claim 31 is rejected under 35 U.S.C. 103(a) as being obvious over Mendenhall in view of Badesha and Pfeiffer and further in view of Chu and Hogg; and claim 71 is rejected under 35 U.S.C. 103(a) as being obvious over Mendenhall in view of Badesha and Colella and further in view of Chu and Hogg. As noted earlier, the independent claims are already amended herein to more clearly distinguish the rejected claims over their respective base combinations.



Further, in each case, the Examiner acknowledges in the Office Action that the base combination does not teach to determine the cloud water content based on a cloud water content formula. However, the Examiner asserts that Chu and Hogg teaches the use of a cloud water content formula to study the signal degradation caused by clouds, and argues that it would have been obvious for one of ordinary skill in the art at the time the invention was made to apply cloud water content formula to the systems defined by the base claims to analyze the influence of clouds on the satellite signals.

The Applicant respectfully disagrees. As discussed earlier, Chu and Hogg is directed to a mathematical model for calculating the attenuation for optical and infrared signals passing through rain and fog. However, the results in Chu and Hogg, which relate attenuation to water vapor density, are limited to terrestrial communications where the water vapor density of ground fog can be quantified. Chu and Hogg does not provide a formula for cloud water content which expresses the cloud water content in the vicinity of a terrestrial base station as a function of an exceedance probability and the longitude and latitude of said terrestrial base station, as the rejected claims require. Hence, the Chu and Hogg reference fails to cure the acknowledged deficiencies in the teachings of the base combinations regarding ground-satellite communication at infrared wavelengths, as discussed above. Accordingly, it is respectfully submitted that claims 6, 13, 31, 63, 68 and 71 patentably distinguish over the applied references, whether considered individually or in combination.

In the Office Action, claims 5 and 30 are rejected under 35 U.S.C. 103(a) as being obvious over Mendenhall in view of Badesha and further in view of Pfeiffer et al. (U.S. Patent No. 5,960,097); and claim 12 is rejected under 35 U.S.C. 103(a) as being obvious over Mendenhall in view of Badesha and Ross and further in view of Pfeiffer. It is respectfully that claims 5, 12 and 30 are allowable for at least the reason that they depend directly or indirectly from allowable claims.

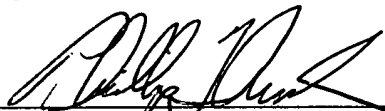
The Examiner relies on Pfeiffer as disclosing the use of an exceedance probability method to analyze the influence of background clutter on a missile detection and tracking system. The Examiner argues that the problem in Pfeiffer is analogous to signal degradation of the satellite communications system by water content in the clouds. The Applicant respectfully disagrees. The only similarity may be that both processes have a random quality. However, in

the present invention, "exceedance probability" is used as an input variable in determining cloud water content according to the formula in Figure 7, rather than being the result on any sort of signal analysis. In the present application, the term "exceedance probability" refers specifically to the probability that the cloud water content at a particular location will exceed the value being calculated (see Figure 7), before rain occurs. The prior art (Barbaliscia et al.) was limited to zenith attenuation at millimeter wave frequencies for 99% "non-rainy" conditions (see application page 14, lines 14-21). The present invention allows cloud water content to be calculated assuming different exceedance probabilities. Choosing a higher value, such as 10%, for example, results in a communications link with lower nominal cloud water content, and therefore less zenith attenuation (see, for example, application at page 17, lines 10-15).

In summary, it is respectfully submitted that the application, as now amended, is in condition for allowance. Notice of such allowance and the passage of this application to issuance are respectfully solicited.

Should the Examiner feel that a conference would help to expedite the prosecution of this application, the Examiner is hereby invited to contact the undersigned counsel to arrange such an interview.

Respectfully submitted,



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October 11, 2006  
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